



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

The Journal of Parasitology

Volume 1

MARCH, 1915

Number 3

SPIDER POISON

VERNON L. KELLOGG

Stanford University, Cal.

The not-infrequent occurrence of the notorious "black widow" spider, *Latrodectes mactans*, in the vicinity of Stanford University, has led me to a limited personal attention to the subject of spider poison and its effects. For this spider, as is well known, has the unsavory reputation of being one of the most poisonous of all spider kinds. The matter was given an added interest for me when Dr. E. H. Coleman, a young graduate in medicine beginning a practice in the village of Los Altos, 5 miles from the university, and registered with me as a graduate student, reported a personal knowledge of two cases of the biting of human beings by *Latrodectes*, both of the cases resulting in an immediate serious condition of the patients. Dr. Coleman, in his turn, became much interested in the spider and its poison and besides noting and recording very carefully the effects of the poison on his patients, was led to the preparation of a much-diluted extract of the poison, with which he experimented on cats and rabbits and even on himself with no uncertain results, and later, under very interesting circumstances, on a patient suffering from angina pectoris.

The genus *Latrodectes* contains several species which are scattered widely over the world. A species (*L. malmigniatius*) of South Europe, is familiarly known and feared under the common name of "la malmigniatte" and another species of New Zealand is called "Katipo" by the natives, and is also much feared. In the two American continents three species occur, of which the most widely distributed and abundant one is *Latrodectes mactans*, which has a range from the northern boundary of the United States to Tierra del Fuego. It is a common spider in our Southern and Southwestern states. Of the other two American species, one (*L. curacaviensis*) is recorded only from the West Indies and the eastern countries of South America, while the other (*L. germetricus*) is called by Petrunkevitch a tropical species, but Comstock states that it has been taken in California. It certainly is not familiar here.

All the species agree in general appearance and size, the female, which is much larger than the male and with nearly spherical abdomen, while the male has a more elliptical abdomen, being about 12 mm. in length and sooty-black or dark brown in color, with a conspicuous small blotch or blotches of vivid red on the under side of the abdomen. This blotch or pair of fusing blotches has the rough outline of an hour-glass. However, it varies much in shape. The position of the spot and its vivid color contrasting with the sooty background are its distinguishing characters.

The species of *Latrodectes* seem to be feared wherever they occur. Comstock quotes Cambridge as referring to them as "those very interesting spiders which, under various local names, have been notorious in all ages and in all regions of the world where they occur on account of the reputed deadly nature of their bite." But to this Comstock says: "It may be added that this belief is not shared by students of spiders, and has probably been suggested by the strongly contrasting colors of the more common species which make them appear venomous to the credulous observers." To this I may in turn add that at least one student of spiders, though incomparably less experienced than Comstock, does share the belief in the unusually poisonous nature of *Latrodectes mactans*. This belief is based chiefly on the notes of Dr. Coleman, which are printed herewith.

But there are other printed records of presumable trouble from *Latrodectes* bites, and still other records which have been given me verbally from a few sources here in California, that bolster up this belief. The best known printed records of the effects of presumable *Latrodectes* bites in this country are those published in 1889 in *Insect Life* (vol. I, pp. 204-211, and 280-282).

Dr. Coleman's notes of the effects of *Latrodectes* poison on a patient, on himself and on cats and rabbits are, in his own words, as follows:

EFFECTS ON A BITTEN PATIENT

Patient B. came to my office one morning at 8:15 o'clock, showing signs of an acute poisoning of some sort.

The glans of the penis had been bitten by a spider while the patient was sitting in an outcloset. The only thing felt was a sharp sting. (The spider was captured so there is no doubt as to the species; it was a female of *Latrodectes mactans*.) In about ten minutes there appeared dizziness and weakness of the legs, followed by cramps in the abdominal muscles.

The patient left the field where working and started to walk to town, a distance of a little over a mile. The pains grew worse and the penis started to swell and turn red. When the office was reached, the pains, of a cramp-like character, in the abdomen, were intense, also around the heart and thighs. Physical examination showed the heart to be running at the rate of 40 per minute, of small volume but regular. The respiration was labored. The pupils were dilated and face very red and congested. The penis was swollen to a great size, fully 3 inches in diameter at the glans, and the color was a mottled

purple. The contractions were clonic in character, giving the greatest pain in the chest and abdomen. There were no pains below the knees or elbows.

The treatment consisted of hypodermic injections of strychnin 1/40, followed in ten minutes by nitroglycerin 1/100. Local applications to the side of bite of the crystals of potassium permanganate. The heart went to as low as 27 beats to the minute. After three hours' work, using repeated injections of strychnin, the heart-rate was increased to 45. The pains were not quite so severe and the patient was taken home. The administration of strychnin was stopped and the use of brandy hypodermatically was substituted, a dose of 10 mm. being given every hour. Heat was applied to the feet and back. At 5 p. m., or about nine and one-half hours after the first symptoms, the heart-rate had been raised to 55 and then as the pains were still severe, a $\frac{1}{4}$ morphin with 1/150 atropin was given. The pains eased up and the patient dropped to sleep.

The next morning a fine rash appeared all over the body, accompanied by some itching. The penis had returned to nearly normal in size. The heart-rate was 60, the respiration 18 and deep, temperature 100. The rash disappeared in four days. The patient was troubled with insomnia for several days, and a stubborn constipation that took a very active purge to affect.

Three years have elapsed and the patient has a heart-rate of about 64. No history of what it was before poisoning. Troubled with attack of insomnia and a marked bulimia.

EFFECTS OF THE EXTRACTED POISON ON THE EXPERIMENTER

The poison glands of a female *Latrodectes* were dissected out. The sac contained a very small drop of liquid of a white viscid character. The sac and contents were macerated in 10 drops distilled water, called solution No. 1, for several minutes. To this was added 100 grains of pure sugar of milk and the mass triturated for fully ten minutes. This was labeled No. 2. Ten grains of No. 2 was added to 90 grains of fresh milk sugar and triturated, making No. 3. Tests were made with trituration No. 3 or a 1/1,000 gr. of the poison in each grain; and also No. 2 with practically the same results, except that No. 2 was vastly stronger than No. 3.

Using No. 3, I made powders containing 2 grains each and took one powder every hour for ten doses, or 0.002 grain poison per dose. (My condition before starting test was pulse 72, respiration 18, temperature 98, bowels regular daily and no pains or aches.) At the end of ten hours no change could be felt, other than a decrease in heart action to 64. No powders were taken from 8 p. m. until 7 a. m. the second day. When 15 powders were taken, the heart action was 60, and a slight dull occipital headache. The bowels did not move at their regular hour in the morning. When 20 powders were taken, the heart-rate was 54, the occipital pain was quite severe, cramping pains were extending from the chest to the abdominal muscles, the pupils slightly dilated, and some distress about the heart. Again no powders were taken during the night; but I was very restless and could not sleep. Continued the powders on the third day and stopped when the twenty-fifth had been taken. The heart-rate was 48, temperature 99, very severe headache, clonic spasms of the thoracic or abdominal muscles, marked distress about the heart with radiating pains extending to the left arm-pit and down to the elbow; had no bowel action for two days; pupils markedly dilated. It seemed a perfect picture of angina pectoris. The symptoms gradually subsided and in three days felt normal. I allowed a period of two weeks to intervene and repeated the experiment with the same symptom-complex picture. The trial was repeated a third time, with always the same results, as to occipital headache, constipation and clonic spasm of the muscles of chest and abdomen; also the pain and distress about the heart. I was unable to persuade any of my friends to try out the drug, so am limited to my own symptoms for a drug picture in the human species.

EFFECTS OF THE EXTRACTED POISON ON RABBITS, CATS AND DOGS

Several experiments were tried on rabbits and cats with very interesting results.

1. The dissected glands of one female *Latrodectes* containing the virus. The virus was macerated in 10 drops distilled water. The same was injected subcutaneously into the abdomen of a cat about 8 months old. In about five minutes a series of convulsions set in of a clonic type, quickly followed by a tonic spasm and in ten minutes the animal was dead.

2. A pair of glands were macerated in 10 gts. of water and diluted to 100 c.c. Ten gts. of this dilution were injected into the abdomen of an 8-months-old cat and there resulted in five minutes dilatation of the pupils, unsteady gait, drooling of saliva, followed by a series of clonic spasms. The heart-rate lowered markedly and the abdomen swelled up to a large size. The feces and urine were passed involuntarily. Death occurred in forty-five minutes after injection.

3. A quantity of the eggs of the *Latrodectes* was macerated in 20 gts. of water and diluted up to 10 c.c. The injection of this solution produced the same typical symptoms and death to a cat 8 months old in about three minutes. A rabbit was killed in about two and one-half minutes.

Ten c.c. of the same solution was injected into a dog about 2 years old and weighing 35 pounds, but there was no marked effects, except a lowering of the heart-rate; no death or convulsions. This experiment was not repeated.

EFFECTS OF THE EXTRACTED POISON ON A CASE OF ANGINA PECTORIS

The most interesting test of the poison was on a man 54 years of age, Mr. E., who had been troubled with pain and distress about the heart; pains that were of a constricting nature and which radiated to the arms. A good case of angina pectoris. A rigid position when the spell was on, clutching at any support, dilatation of the pupils and slow heart action. This patient had had several of these attacks, which continued intermittently for about one-half hour at each seizure. During one attack I gave one 2-grain powder of the No. 3 trituration or one hundredth dilution and in ten minutes the attack passed away, leaving the patient more comfortable than after any previous attack. This follows the "similia similibus curantur" of the Hahnemannian teaching and surely worked wonders in this one instance. No opportunity to repeat the trial, because one month later the patient was taken with another attack of a similar nature and before help could reach him, passed away.

These observations and experiments of Dr. Coleman seem to me to be of themselves sufficient evidence to show the really deadly character of *Latrodectes* poison. But there is other evidence of similar import, obtained in a different way. It is the evidence from the work of the Germans, Sachs and Kobert, on the hemolytic effects of spider poison, and the isolation from the spider body of a specific poisonous principle named "arachnolysin," which is a powerful hemolysin, proved by experiment to have very definite action on the blood of various animals, such as rabbits, rats, mice, geese and man.

Dr Hans Sachs (Beiträge zur Chemischen Physiologie und Pathologie, vol. ii) records the results of a study of the hemolytic action of the poisonous principle in the body fluid and poison glands of the diadem spider, *Epeira diadema*. The author first refers briefly to the present status of the general knowledge of the hemolytic effects of spider poison. By spider poison is not meant necessarily simply the

secretion of the poison glands, but also that substance carried by the body fluids or body tissues which seems to have, as well as the specific secretion of the poison glands, a poisonous effect on other animals. The author then describes elaborately the technic by which he made the extraction of a poisonous principle from the crushed and macerated whole body of the spider. This principle, the arachnolysin, causes, almost immediately, a dissolving of the sensitive blood corpuscles when introduced into blood taken from various birds and mammals, including men. In its behavior the arachnolysin shows a certain analogy with the venom of serpents and is distinguished by its immediate effects from the hemolytic behavior of blood-serum which acts only after a longer or shorter period of incubation. Curiously enough, the diadem spider's poison had no effect on the blood of guinea-pigs, dogs, sheep or horses. Its strongest effect was on the blood of rabbits and rats, next on mice, next on that of man, next on that of the ox and last, although still fairly strong, on that of the goose. A diadem spider of 1.4 gr. contains sufficient poison to destroy completely all the corpuscles in 2.5 liters of rabbit blood. This puts arachnolysin in the class of the strongest kinds of blood poisons.

Arachnolysin is easily destroyed by high temperatures. If it is exposed to forty minutes' continual heat of from 70 to 72 C. it is wholly destroyed. It can withstand a temperature of 56 C. for forty minutes, while a temperature of 60 C. for forty minutes reduces its effects only slightly. It can be preserved in glycerin for months in full strength of effect.

Sachs made experiments on immunizing, but they were limited by lack of material and he gives very little account of them. However, he mentions that shortly before his work was finished he was able to produce a highly effective antitoxic serum by treatment of the blood of guinea-pigs with arachnolysin; 0.0025 c.c. of this antitoxin serum is sufficient to protect 0.05 c.c. of rabbit blood from an otherwise hemolyzing dose of arachnolysin.

Kobert (*Lehrbuch der Intoxicationen*, 1893; and *Beiträge zur Kenntniss der Giftspinnen*, 1901) describes his studies of the poison of the diadem spider and also of *Latrodectes*. He distinguishes between the actual secretion of the poison glands and a toxalbumen which exists everywhere throughout the whole body of a spider, especially in the legs and the eggs. (Dr. Coleman was able, it will be remembered, to kill a rabbit in two and one-half minutes and a cat in three minutes by injecting a solution derived from macerating the eggs of *Latrodectes*.) The more of the toxalbumen which penetrates the wound, so much the stronger, according to Kobert, are the general poisonous effects. While the more of the actual secretion of the poison

glands which goes into the wound, so much the stronger are the local effects, especially in the case of species of *Latrodectes*, which "produce by their bite," says Kobert, "the most serious general results, and are capable of killing even men." The secretion of the poison glands may be made more dangerous by far by its mixture with the toxalbumen of the general body. In the case of the diadem spider, Sachs found that while only local irritating results are produced by its bite, it possesses also in its body a toxalbumen analogous to that determined by Kobert for the *Latrodectes*, which, however, does not form part of the secretion of the poison glands. In the light of this fact, Sachs holds it to be very probable that the hemolytic results described by him are practically identical with the results referred by Kobert to toxalbumen.

Kobert describes the hemolytic working of both *Latrodectes* and diadem spider poison. He found the hemolytic effects of the latter to be real, but much less in degree than that of the *Latrodectes* poison. Kobert found the *Latrodectes* poison to be effective on dog blood which was one of the kinds of blood which Sachs found to be practically immune to diadem poison, so that perhaps the *Latrodectes* poison would be found to be even more serious in the case of those kinds of blood which Sachs found to be affected by the diadem spider's poison. Kobert also determined that a certain immunity or an acclimatization to *Latrodectes* poison as well as to diadem poison, can be brought about.

The results of the careful work of Sachs and Kobert prove conclusively the active and formidable character of spider poison. In ordinary biting by spiders, a very small quantity of poison finds its way into the wound; not enough to trouble, in most cases, a human being. But with *Latrodectes* the poison seems more effective. A small amount injected by a single bite can threaten the life of a man. Probably with *Latrodectes*, as with other animal poisons, the physiological idiosyncrasies of the particular man bitten play an important part in determining the degree of seriousness of the trouble produced. Some of us are badly injured by a bee's sting; most of us are not. To most of us a rattlesnake's bite would be serious; to a few of us, it would not be. I can believe that the bite of *Latrodectes* would not be serious to certain men; I must believe that it can be serious to some; for it has been.